dependent on calcium for its function, it is not surprising that calcium channel blockers have specific value in the treatment of cardiovascular disease. The calcium channel blockers most recently released in the United States for commercial use are nifedipine and diltiazem hydrochloride.

At the recommended dosage, nifedipine, unlike verapamil hydrochloride, has no effect on the sinoatrial or atrioventricular node. In addition, it does not significantly depress myocardial contractility. It can, therefore, be used safely in patients with conduction abnormalities and congestive heart failure. Its major target tissue is vascular smooth muscle. Of the calcium channel blockers currently available, nifedipine is the most potent vasodilator. Its use in the emergency room is dependent on this effect. Nifedipine produces coronary artery dilation, rendering it very effective for treating vasospastic (Prinzmetal's) angina. Given sublingually, it is simple to administer and acts rapidly. Nifedipine also induces systemic vasodilation and is emerging as an effective drug for control of cases of hypertension in the emergency room. Unlike other calcium channel blockers, tachyphylaxis to its antihypertensive action has not been reported. For patients with diastolic pressures lower than 110 mm of mercury, 10 mg given sublingually or orally usually achieves good control. For diastolic pressures greater than 110 mm of mercury, 20 mg is given. An additional 10-mg tablet can be given after one hour if necessary. A mild increase in heart rate of approximately ten beats per minute may result.

Long-term use of nifedipine does not produce sodium retention, plasma volume expansion or renin release. Combining it with propranolol hydrochloride provides additional antihypertensive control, blocks the reflex increase in heart rate and permits twice-a-day dosage of nifedipine. Methyldopa can also be used but the nifedipine must be given every six hours. Mild pedal edema can be managed with the use of diuretics. Because vasodilation with subsequent afterload reduction decreases myocardial oxygen consumption, nifedipine is also effective in treating classical angina; it is infrequently used in emergency departments for this indication, however, because of the efficacy of nitroglycerin.

Diltiazem is the latest calcium channel blocker to be released. Its actions are intermediate to those of verapamil and nifedipine. Diltiazem is equivalent to verapamil in depressing atrioventricular node conduction, but produces less refractory period prolongation. Therefore, it is effective in treating paroxysmal supraventricular tachycardia and atrial fibrillation or flutter, but may be safer than verapamil in patients receiving digoxin or those with atrioventricular nodal disease. However, diltiazem has a greater inhibitory effect on the sinoatrial node and is more dangerous in patients who have sick sinus syndrome. Diltiazem is indicated for the treatment of cases of both types of angina, producing more vasodilation than verapamil but less than nifedipine. In addition, diltiazem has less negative inotropic activity than verapamil. Although possessing some theoretic advantages, diltiazem has not proved clinically superior to the other calcium channel blockers in the emergency setting. Therefore, it has no specific indication in emergency medicine at the present time. Except for its use in treating congestive heart failure, it has the same contraindications as verapamil.

None of the calcium channel blockers currently available are effective in cerebral salvage after cardiac arrest. However, newer calcium channel blockers, such as lidoflazine and flunarizine hydrochloride, have prevented neurologic deterioration after brief periods of global ischemia in laboratory animals. Studies are currently in progress evaluating their effects in humans.

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New Diagnostic Tests of Blunt Cardiac Trauma

MYOCARDIAL CONTUSION is an elusive clinical disorder. The absence of both a simple, accurate screening test and a diagnostic gold standard causes confusion. Moreover, no good clinical studies accurately define short- and long-term morbidity and mortality.

The workup of patients in an emergency department who have possible cardiac contusion includes a history, a physical examination and electrocardiography. The reported sensitivity and specificity for electrocardiographic prediction of cardiac contusion are variable and depend on the diagnostic criteria used. If the mechanism of injury is of high risk for cardiac contusion, the patient is admitted and CPK-MB isoenzyme studies are done. The presence of CPK-MB isoenzyme was initially thought to represent the gold standard for diagnosing cardiac contusion; recent reports, however, have shown a lack of specificity in patients with multiple trauma, even when CPK-MB ratios are used. Nevertheless, it does appear to be the most sensitive of currently used screening tests, and a clinical suggestion of cardiac contusion warrants that both an electrocardiogram (ECG) and CPK-MB values be obtained.

Radionuclide scans with technetium Tc 99m pyrophosphate have a low sensitivity for cardiac contusion and should no longer be used.

Recently, two relatively new diagnostic methods have shown promise: multiple-gated acquisition (MUGA) radionuclide scans and two-dimensional echocardiography. The MUGA scan is useful in determining whether continuing hemodynamic instability may be due to cardiac contusion.

Most patients suspected of having a cardiac contusion are young and otherwise healthy. Consequently, segmental wall dysfunction on MUGA scan is felt to be specific for cardiac contusion in young, previously healthy trauma victims.

Advantages of the multiple-gated acquisition scan include

- Cardiac dysfunction caused by cardiac contusion can be documented and a patient appropriately managed;
- Serial MUGA scans document the course of hemodynamic compromise. In one large series 27 of 32 patients with abnormalities on a MUGA scan subsequently had improvement or resolution of their wall motion defect on follow-up scans, indicating recovery of the contused myocardium;
- The test is relatively noninvasive and can be done with a portable γ-camera in an intensive care unit.

Disadvantages of the MUGA scan include the following:

- Lack of 24-hour availability in most hospitals;
- Hypovolemia may cause the scan to be falsely positive due to decreased cardiac filling;
- Older patients with preexisting cardiac disease may have positive findings from nontraumatic causes;
- The predictive relationship between the scan's findings and morbidity and mortality has not been clearly established.

Two-dimensional echocardiography may prove to be of use in the future; a recent report indicates that two-dimensional echocardiography can detect complications of cardiac contusions.

Emergency physicians must continue to rely on "clinical suspicion" and ECG findings in screening patients with possible cardiac contusion. Identifying CPK-MB isoenzymes is best used to screen trauma patients requiring hospital admission. For hemodynamically unstable patients, portable MUGA scans can be done in an intensive care unit. With hemodynamic monitoring, MUGA scans provide the best current method for determining the presence of hemodynamic instability due to cardiac contusion.

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Conjunctival Oximetry

MAINTAINING ADEQUATE tissue oxygenation to prevent anaerobic cellular metabolism is a major function of the cardiorespiratory system. Clinical assessment of this important physiologic variable was not possible before the development of miniaturized polarographic oxygen electrodes that could be placed directly on peripheral tissue sites. Initially, transcutaneous oxygen sensors were used; these sensors required heating to liquefy the stratum corneum so that oxygen could diffuse from the subcutaneous capillary bed to the oxygen electrode. Transcutaneous sensors introduced artifacts in the measurement of tissue oxygenation because the heated electrode produced increased tissue metabolism, reactive hyperemia and a rightward shift of the oxyhemoglobin disassociation curve in the area beneath it. In addition, the prolonged stabilization period (longer than ten minutes) and the relatively slow reaction time to clinical events prevented widespread use of the transcutaneous oxygen sensor in emergency medicine.

The recent development of a conjunctival oxygen sensor has permitted direct measurement of tissue oxygenation ($Pcjo_2$) without heating artifacts. The miniaturized oxygen electrode is mounted on a polymethyl-methacrylate ocular conformer, so that on insertion the electrode lies against the lateral, superior palpebral conjunctiva. Because no stratum corneum is present on the conjunctiva, an unheated oxygen electrode is used. The capillary bed is located about 30 microns from the conjunctival oxygen electrode and $Pcjo_2$ values have been calculated to be from 5 to 10 torr less than capillary oxygen tension. The conjunctival sensor can be rapidly inserted without patient discomfort, and can be left in place for up to 24 hours. Stabilization of the conjunctival sensor is almost immediate, so that meaningful values of conjunctival oxygen tension are available within 60 seconds of insertion. The response time of the conjunctival sensor to physiologic state changes is rapid, usually from 30 to 60 seconds.

In normovolemic patients with a normal cardiac output, $Pcjo_2$ is about 70% of partial pressure of arterial oxygen (Pao_2), and these two variables track each other closely. In this setting, $Pcjo_2$ can be used as a continuous, noninvasive monitor of Pao_2 and respiratory state.

Because the conjunctival sensor measures tissue oxygenation at a peripheral site where perfusion is affected at an early stage of physiologic instability, measuring the $Pcjo_2$ can identify important alterations in clinical state before other noninvasively measured variables, such as blood pressure, respond to the changing situation. Decreases in peripheral tissue oxygen delivery and perfusion due to factors such as hypovolemia or poor cardiac function will result in disassociation of $Pcjo_2$ and Pao_2.

In a series of normotensive trauma patients with no history of cardiac disease, a $Pcjo_2/Pao_2$ ratio of less than 0.5 predicted an intravascular volume deficit of 15% or greater. Normalization of the $Pcjo_2/Pao_2$ ratio—that is, to values greater than 0.5—occurred with volume resuscitation. Deterioration of previously stable $Pcjo_2$ values, presumably reflecting decreasing cardiac output, preceded cardiac arrest by three to four minutes in critically ill patients; return of a viable cardiac rhythm was accompanied by a rise in $Pcjo_2$ from the values present during cardiopulmonary resuscitation.

The $Pcjo_2$ provides a unique measure of physiologic state, capable of detecting alterations in a patient's clinical condition before traditionally measured indicators show changes. Conjunctival oxygen measurement represents a major advance in noninvasive monitoring.

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Viral Hepatitis Type B Vaccine

VIRAL HEPATITIS type B attacks an estimated 200,000 people a year in the United States. Although most patients recover completely, in 1% to 2% of those admitted to hospital, fulminant hepatitis develops and 6% to 10% become chronic carriers of the disease.

The eight-year-old viral hepatitis type B (HBV) vaccine consists of a non-disease-producing hepatitis B surface antigen (HBsAg) protein extracted from the plasma of asymptomatic carriers. Multiple purification processes effectively inactivate all other known infectious agents. The vaccine inhibits the occurrence of disease or modifies its manifestations if given before or during the incubation period.

The HBV vaccine is recommended as routine immuniza-